Feb. 8, 1927. 1,616,666

L. E. NEBERGALL

DRILL COLLAR FOR HYDRAULIC ROTARY DRILLS

Filed March 5, 1923

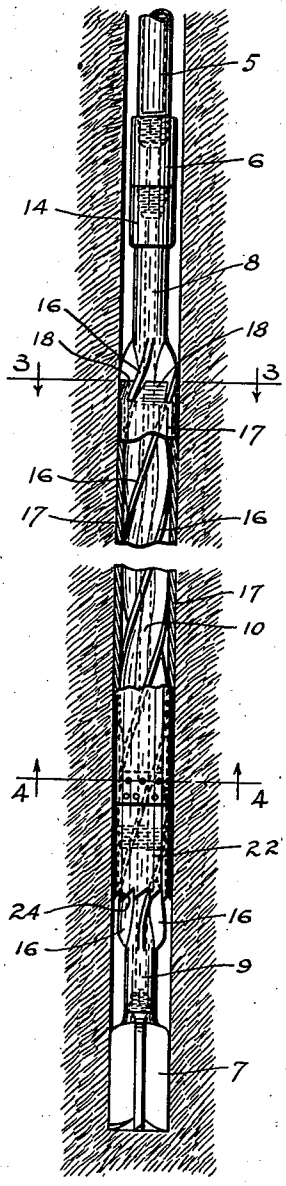


Fig. 1.

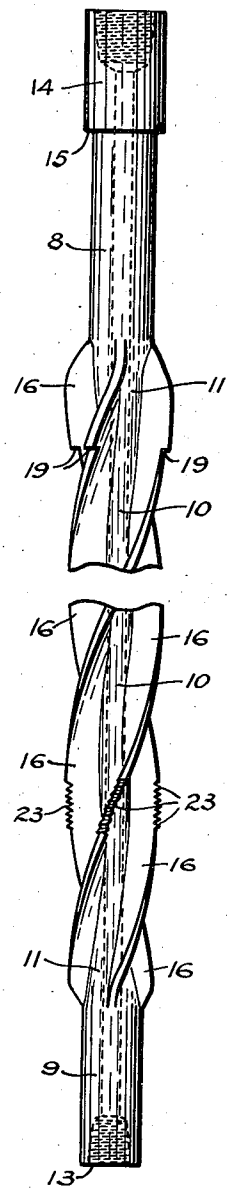


Fig. 2.

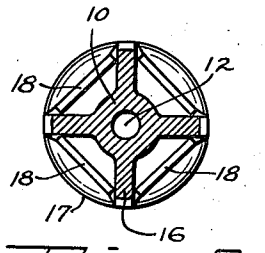


Fig. 3.

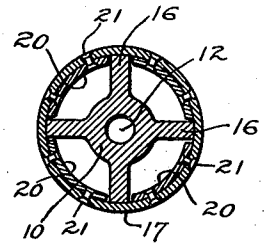


Fig. 4.

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UNITED STATES PATENT OFFICE.

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DRILL COLLAR FOR HYDRAULIC ROTARY DRILLS.

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My invention relates to tools and appliances for drilling artesian and oil wells, and particularly to devices for use in connection with hydraulic rotary drills. It is the object of my invention to provide means in connection with a hydraulic rotary drill whereby to insure the drilling of a straight vertical hole, and to prevent the turning aside or lateral deflection of the drill by obstructions of the various kinds encountered in broken, irregular and slanting geological formations, which result in the production of crooked holes, so that the well-casing cannot be inserted, and which may also cause the drilling tools to be broken off and stuck in the hole, so that the drilling operations cannot be completed. A more particular object of my invention is to provide for hydraulic rotary drills a drill collar or member which is connected directly with the rotary bit and extends above the same for a considerable distance, the said member or drill collar being of substantially the same diameter as the bit, so as to fit within and be guided by the sides of the hole, whereby to prevent lateral deflection of the bit. A further object of my invention is to provide for the aforesaid drill collar a removable external shell or sleeve which may be readily renewed when worn, and to provide at the lower end of said shell a shoe having cutting edges which serve to ream and definitely size the hole in advance of the guiding portion of the collar. A further object of my invention is to provide a drill collar adapted to directly guide the rotary bit by reason of having a diameter substantially the same as the bit, and of such sectional form that the same may be of the required length for efficiently guiding the bit without being of excessive weight.

In the accompanying drawings Fig. 1 is a vertical sectional view, showing in use the lower portion of a hydraulic rotary drill mechanism including a drill collar embodying my invention, a portion of the shell or wear-sleeve being in section, and a portion of the drill collar intermediate its ends being broken away to avoid excessive length of the drawing without employing a greatly reduced scale therefor, Fig. 2 is a detail side view of the main portion or stem of the drill collar, some of the intermediate winged portion thereof being broken away, Fig. 3 is a transverse section of the drill collar on the line 3—3 of Fig. 1, and Fig. 4 is a transverse section of the same on the line 4—4 of Fig. 1.

It will be understood that the devices herein particularly described are used in connection with a hydraulic rotary drill outfit of the usual and substantially standardized type, wherein the power for driving the rotary bit is transmitted through a string of drill-pipe which also serves to carry to the bottom of the hole the water or slush for flushing out the loosened material and for sealing off gas or water encountered in porous strata above that which the hole is desired to reach. In the usual practice in rotary drilling, the drill-pipe and rotary bit are connected to each other by an intermediate member designated as a drill collar, the same being a tubular body internally threaded at its lower end to receive the taper-threaded pin of the bit, and threaded at its upper end to receive the pin-end on the lower section of the drill-pipe. The device provided by my invention is to be used in place of the usual drill collar, and hence is designated by the same name, although it has additional functions.

In the illustrated structure the drill-pipe 5 has at the lower end thereof the usual pin-end 6, and the rotary bit 7 is of the common four-wing type, having a taper-threaded pin at the upper end of its tubular shank. The drill collar has an integral tubular body or stem, of which the upper and lower end-portions 8 and 9 are cylindrical and of slightly larger diameter than the intermediate cylindrical portion 10, with which said cylindrical end-portions are united by tapering or slightly conical portions 11. The opening 12 through the entire stem forms a continuation of the water-passage through the drill-pipe and the shank of the bit. At the lower end of the portion 9 the same is internally threaded to form a box 13 for receiving the pin of the bit, and at the upper end of the portion 8 there is a slightly enlarged head 14 which is threaded internally to form a box for receiving the pin of the member 6. The shoulder 15 formed at the lower end of the head 14 is adapted for engagement by an overshot, and is for use in fishing operations should the tools be dropped in the hole by reason of breaking of the pin-end 6 or of the drill-pipe adjacent thereto.

Upon the intermediate stem-portion 10 and the tapered portions 11, and formed

integrally therewith, are a plurality of ribs or wings 16 which in transverse section extend radially of the longitudinal axis, and which are preferably inclined or twisted helically about said longitudinal axis. At the upper and lower ends of the wings their outer faces are inclined toward the stem-portions 8 and 9, terminating at the larger ends of the tapering portions 11. For a short length near their upper ends the diameter between the outer faces of the oppositely disposed wings is substantially the same as the diameter of the rotary bit or of the hole in which the tool is used. Below said upper end-portions of the wings the diameter across the same is reduced by the thickness of the shell or wear-sleeve 17, which fits around the wings as indicated in Fig. 1. The upper end of the shell 17 is notched to form a series of lugs 18 which extend between the upper portions of the wings, said lugs being bent inwardly as indicated in Fig. 3, whereby to avoid the formation of a square offset or shoulder between the wings at said upper end of the shell, as such a shoulder might interfere with the removal of the tool from the hole. The downwardly facing shoulders 19, at the end of the reduced portions of the wings, seat against the bottoms of the notches in the upper end of the shell. The lugs 18, by entering between the wings in the manner indicated, prevent relative rotation of the shell and the winged stem, and such rotation is also prevented by means of plates 20 which are secured by rivets 21 within the lower end-portion of the shell, between the wings 16, as clearly shown in Fig. 4. The shell terminates at some distance above the lower ends of the wings, and below the lower end of the shell there is arranged a member 22 of which a portion is internally threaded and screwed onto threads 23 formed on the outer faces of the wings as best shown in Fig. 2. In practice, said member 22 is a rotary shoe, such as is commonly used with rotary well-drilling outfits when sinking well-casing, the shoe being screwed onto the lower end of the casing-pipe, and having saw-teeth or cutting edges at its lower end, which serve to ream the hole and clear a passage for the casing. In the present case the shoe or member 22 has saw-toothed cutting edges 24 at its lower end which serve to ream and smooth the sides of the hole, and the shoe also serves the purpose of retaining the shell or wear-sleeve in longitudinal position upon the winged portion of the stem, by engaging the lower end of said shell and pressing the upper end thereof against the shoulders 19. Below the threads 23 the diameter across the wings is reduced to the root-diameter of said threads, so that the shoe may be screwed onto and off the threaded portion. When the shoe is removed the shell is freed so that it may also be withdrawn off the lower end of the stem, or replaced in position thereon.

When my drill collar is in use the drilling operation proceeds in substantially the usual manner, the string of tools being rotated and gradually lowered into the hole, while water or slush is forced down through the drill-pipe and the drill collar to the bottom of the hole. The return flow of the slush from the bottom of the hole passes through the collar, inside the shoe 22 and shell 17, and between the wings 16 to the upper end of the shell. Thence the flow is through the space around the drill-pipe in the usual way. It will be understood that the drill-guiding collar is of great length, relative to the diameter thereof, whereby to effectively hold the bit in a true vertical position notwithstanding minor irregularities in the sides of the hole, such as might result from caving and dislodgment of bodies of material outside the normal area of the hole. In practice, the length of the drill collar should be not less than ten feet, and may be as much as twenty-five feet or more, according to the diameter of the hole being drilled, and the known tendencies of the geological formations penetrated to deflect the drill from vertical alinement. The smoothing of the sides of the hole which results from the reaming action of the cutting edges of the shoe 22, assists materially in the formation of firm non-caving walls or sides, and this effect is further enhanced by the shell 17 which protects the recently cut sides of the hole from the erosive action of the upwardly flowing stream of slush. The shell, rotating in contact with the sides of the hole, also has a tendency to rub or plaster into the same the clay, silt or other suspended material, and thus further assist in the formation of smooth uniformly cylindrical walls.

The drill collar provided by my invention may be advantageously employed for straightening crooked holes which have been drilled by ordinary means, or without the use of the guiding drill collar. When used for this purpose, it is sometimes desirable to omit the shell 17 and shoe 22, thereby allowing the edges of the wings 16 to contact directly with the sides of the hole, and thus have a tendency to ream off the projecting convex surfaces at the places which are out of vertical alinement with the straight portions of the hole. When used in this manner the diameter across the wings, through their length, should be substantially the diameter of the hole which it is desired to produce.

When my drill collar is employed in the original drilling of a hole, it is almost always preferable that the shell or wear-sleeve 17 be employed, and if the device is to be used only for work of this kind the wings

need not be inclined or helically twisted, thereby slightly simplifying the structure and reducing the cost of its manufacture.

Now, having described my invention, what I claim and desire to secure by Letters Patent is:

1. A drill collar for hydraulic well-drilling, comprising a relatively long tubular stem having at its lower end means for detachable connection with a rotary bit and having at its upper end means for like connection with a drill pipe, said stem having wings of substantially uniform thickness throughout their entire width and extending radially from the stem, said wings being continuous longitudinally between points near the ends of the stem and having smooth side faces and forming spirally arranged longitudinal spaces between them constituting channels for the upward flow of slush from the bottom of a drilled hole after the slush has passed the drilling means, and a wear sleeve carried by the collar and fitted about said wings throughout the greater portion thereof and forming outer walls for the said spiral channels to confine the slush between the wings while the slush is passing upward through the channels.

2. A drill collar for hydraulic rotary well drilling comprising a tubular stem of great length having at its lower end means for detachable connection with a rotary bit and having at its upper end means for like connection with a drill pipe, said stem having wings extending radially therefrom, said wings being continuous longitudinally between points near the ends of the stem and having smooth side faces and forming longitudinal passages between them constituting channels for the upward return flow of slush from the bottom of the drilled hole after the slush has passed the drilling means, a wear sleeve fitting about said wings throughout the greater portion of the length thereof, and movable by the stem in the forwarding boring movement of the tool, and means for removably securing the wear sleeve in place, the latter means permitting the passage of the slush through the slush channels.

3. A drill collar for hydraulic rotary well drilling comprising a tubular stem of great length having at its lower end means for detachable connection with a rotary bit and having at its upper end means for like connection with a drill pipe, said stem having wings extending radially therefrom, said wings being continuous longitudinally between points near the ends of the stem and having smooth side faces and forming longitudinal passages between them constituting channels for the upward return flow of slush from the bottom of the drilled hole after the slush has passed the drilling means, a wear sleeve fitting about said wings throughout the greater portion of the length thereof, and a shoe disposed below the sleeve and having cutting edges formed at the lower end thereof, said shoe retaining the sleeve in place and permitting the passage of the slush through the slush channels.

4. Hydraulic rotary well-drilling mechanism comprising in combination a rotary bit and drill pipe for actuating said bit, a relatively long collar connecting said bit and drill pipe, said collar having a central water passage and provided with radially projecting longitudinal ribs having smooth side faces and being of substantially uniform thickness throughout their entire width and forming continuous spirally arranged longitudinal passages constituting slush channels for the upward return of slush from the bottom of the drilled hole after the slush has passed the bit, and a tubular sleeve carried by the collar and fitted about the wings throughout the greater portion of the length of the same and forming outer walls for the said slush channels to confine the slush between the wings during the upper passage of the same in the channels.

5. A drill collar for hydraulic rotary well drilling comprising a tubular stem having at its lower end means for detachable connection to a rotary bit and having at its upper end means for like connection with a drill pipe, said stem having wings extending radially therefrom, said wings having smooth side faces and forming longitudinal slush channels between them, a tubular sleeve fitting about the wings throughout the greater portion of the length of the same and interlocked at its upper end with the same to prevent relative rotary movement, said ribs being provided at the upper end of the sleeve with shoulders for engaging the same and a shoe arranged on the ribs and having a threaded engagement with the same and detachably securing the sleeve in engagement with the said shoulders.

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